**Small Business Innovation Research/Small Business Tech Transfer**

# Nanosat Maneuvering and Orbital Transfer Stage, Phase I

Completed Technology Project (2018 - 2019)

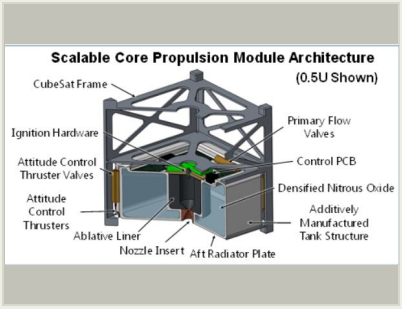
## Project Introduction

The proposed innovation is a modular, high-performance orbital transfer stage (OTS) vehicle for Nanosats and Microsats launched as secondary payloads and require maneuvering to their desired orbits. The OTS has a modular design, and can accommodate payloads ranging from 5kg 3U size Nanosats to >50kg Microsat size vehicles. The propulsion system uses hydroxyl-terminated polybutadiene (HTPB) fuel with nitrous oxide (N2O). These "green propellants" that are sufficiently safe for ridesharing, will provide density impulse over 10-15% higher than a hydrazine system, and are capable of near-impulsive ΔV maneuvers to support launch vehicle collision avoidance operations, final operational orbit insertion, or tactical inclination/plane change maneuvers. The proposed system leverages additive manufacturing as the primary fabrication process incorporating modular tank and thruster configurations with integral Reaction Control Subsystem. Basic Propulsion "modules" can be combined to enable various size vehicles and missions. The basic concept for the OTS "core" configuration is also amenable to integrating the hybrid propulsion directly into a Nanosat bus. The proposed solution will allow lower cost access to space than existing commercial monopropellant system liquid stages, uses a fraction of the power of electric propulsion systems, and will be much safer than systems that use toxic and/or explosive propellants. The OTS will have complete capability (power, guidance and navigation, etc.) to position the Payload spacecraft into their desired orbits.

## Anticipated Benefits

NASA can use the proposed OTS technology to place low-cost small satellite platforms in operational orbits for high-value science missions, using secondary payload ride opportunities. This will enable NASA to explore planets, comets, asteroids, and distant moons at an extremely low cost by using rapidly developing small satellite technology. Other NASA beneficiaries include NASA's CubeSat programs and the Virtual Telescope Alignment System program, which require precision orbit positioning.

Non-NASA customers include universities, emerging Smallsat businesses, and non-profit research institutes with active CubeSat development programs. These customer groups will benefit substantially from low-cost insertion into more desirable orbits. Additionally, organizations such as iCubeSat have made a strong case for the utility of CubeSats in deep space; iCubeSat mission scenarios require significant propulsion capability, and can be served by the proposed OTS system.



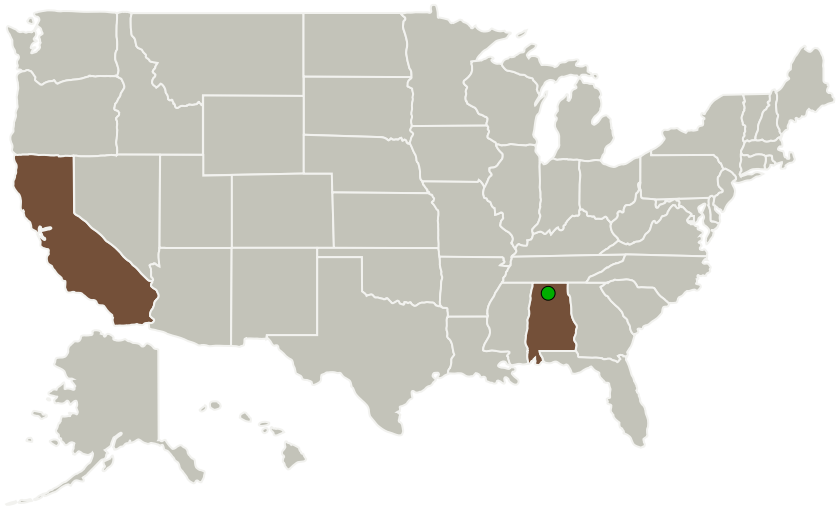

Nanosat Maneuvering and Orbital Transfer Stage, Phase I

## Table of Contents

# Nanosat Maneuvering and Orbital Transfer Stage, Phase I

Completed Technology Project (2018 - 2019)

## Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---|---|---|---|
| Parabilis Space Technologies, Inc. | Lead Organization | Industry<br>Historically Underutilized Business Zones (HUBZones) | SAN MARCOS, California |
| Marshall Space Flight Center(MSFC) | Supporting Organization | NASA Center | Huntsville, Alabama |
| University of Southern California(USC) | Supporting Organization | Academia | Los Angeles, California |

| Primary U.S. Work Locations | |
|---|---|
| Alabama | California |

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Parabilis Space Technologies, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

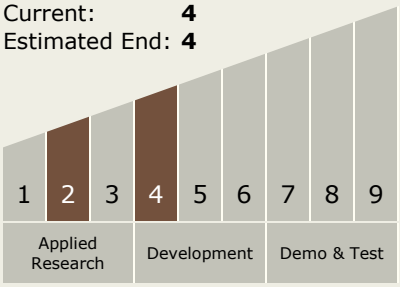
Carlos Torrez

**Principal Investigator:**

Greg Berg

## Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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## Project Transitions

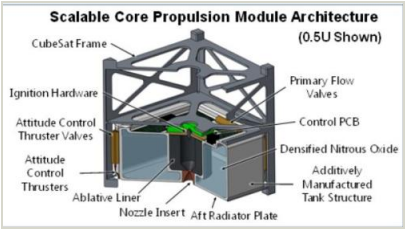
**July 2018:** Project Start

**August 2019:** Closed out

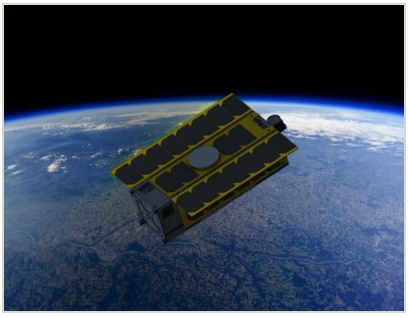
**Closeout Documentation:**

- Final Summary Chart*(https://techport.nasa.gov/file/137871)*

## Images




**Briefing Chart Image**
Nanosat Maneuvering and Orbital Transfer Stage, Phase I
*(https://techport.nasa.gov/image/135311)*



**Final Summary Chart Image**
Nanosat Maneuvering and Orbital Transfer Stage, Phase I
*(https://techport.nasa.gov/image/135062)*

## Technology Areas

**Primary:**

- TX01 Propulsion Systems
  - TX01.2 Electric Space Propulsion
    - TX01.2.2 Electrostatic

## Target Destination

Earth